Mobile WiMAX Business Case

Doug Gray,  doug_gray@cox.net
Sai Subramanian,  sai@navini.com
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Propose Two (or more) White Papers

- Phase I Paper—“A Comparative Analysis of Mobile WiMAX Deployment Alternatives”
  - Would look at different deployment alternatives on the basis of number of BS required to meet specific capacity requirements in hypothetical metropolitan area
    - SIMO, MIMO, Beamforming, & Beamforming+MIMO
    - Reuse 1 vs. Reuse 3
    - 700 MHz, 2500 MHz, 3500 MHz
    - Sensitivity to link budget
    - TDD only (for now)
  - Phase I paper:
    - Will not require core network CAPEX or detailed service provider OPEX
    - Will not provide payback or detailed ROI
    - This detail will be provided in a follow-on, Phase II paper
Key Requirements for Phase I Paper

- Estimate of “Peak Busy Hour” downlink capacity requirements
- Validation of DL channel capacity for various BS and Reuse configurations
- Estimate of average WiMAX equipment costs

These are key discussion points for today’s discussion

Goal: To arrive at some consensus on numbers and methodology
Peak Busy Hour DL Capacity Requirements

• Assume Three Classes of Customers
  – Professional: Heavy user, business applications, large files, office on the move, etc.
  – High-End Consumer: messaging, gaming, etc.
  – Casual Consumer: Light user, voice, e-mails, messaging, some internet browsing, etc.

• DL Capacity Calculation
  – Users are either “Actively” connected to the network or in “Sleep” mode
  – “Actively” connected users are either downloading, uploading, or in “idle” mode, i.e. Reading, Typing, or thinking of next action
## Peak Busy Hour DL Capacity Estimates & Methodology

<table>
<thead>
<tr>
<th>Customer Class</th>
<th>Customer Density</th>
<th>Number Actively Connected During PBH</th>
<th>DL “Duty Cycle”</th>
<th>“Guaranteed” DL Data Rate during PBH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional</td>
<td>“a” per sq-km</td>
<td>1 of 5 (20%)</td>
<td>25%</td>
<td>25 kilobytes/sec (200 kbps)</td>
</tr>
<tr>
<td>High-End Consumer</td>
<td>“b” per sq-km</td>
<td>1 of 10 (10%)</td>
<td>25%</td>
<td>20 kilobytes/sec (160 kbps)</td>
</tr>
<tr>
<td>Casual User</td>
<td>“c” per sq-km</td>
<td>1 of 20 (5%)</td>
<td>25%</td>
<td>10 kilobytes/sec (80 kbps)</td>
</tr>
</tbody>
</table>

Reasonable?
## Relative Downlink Channel Capacity Estimates

<table>
<thead>
<tr>
<th>BS Configuration</th>
<th>Frequency Reuse = 1</th>
<th>Frequency Reuse = 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1x2 SIMO</td>
<td>1.0</td>
<td>1.5</td>
</tr>
<tr>
<td>2x2 MIMO</td>
<td>1.5¹</td>
<td>2.3</td>
</tr>
<tr>
<td>Beamforming</td>
<td>3.0²</td>
<td>3.0</td>
</tr>
<tr>
<td>Beamform + MIMO</td>
<td>5.0²</td>
<td>5.0</td>
</tr>
</tbody>
</table>

1. Based on simulations done for paper “Mobile WiMAX – Part II: A Comparative Analysis”
2. Based on inputs from equipment vendor
### Assumed Average WiMAX Equipment Costs

<table>
<thead>
<tr>
<th>BS Configuration</th>
<th>1-Channel (i.e. Reuse 1)</th>
<th>3-Channel (i.e. Reuse 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1x2 SIMO</td>
<td>$37K</td>
<td>$47K</td>
</tr>
<tr>
<td>2x2 MIMO</td>
<td>$49K</td>
<td>$59K</td>
</tr>
<tr>
<td>Beamform</td>
<td>$55K</td>
<td>$65K</td>
</tr>
<tr>
<td>Beamform + MIMO</td>
<td>$79K</td>
<td>$89K</td>
</tr>
</tbody>
</table>

Assume $7.5K per sector for installation

Numbers need validation:
Too high, Too low, or About right?
For comparative analysis cost differential is most important
Example: Using Current Estimates

- 2500 MHz Band
- 500 sq-km Metro Area
- 100,000 Customers
  - 46,000 Professional
  - 37,000 High-End Consumer
  - 17,000 Casual Consumer
- Greenfield BS at $200K + WiMAX Equipment

<table>
<thead>
<tr>
<th>BS Conf</th>
<th>Channel BW</th>
<th>Available Spectrum</th>
<th>Reuse</th>
<th>Total BS</th>
<th>Total WiMAX BS Equip $M</th>
<th>Relative WiMAX Equip Cost</th>
<th>Total BS Related CAPEX $M</th>
<th>Relative BS Related CAPEX</th>
</tr>
</thead>
<tbody>
<tr>
<td>1x2 SIMO</td>
<td>10</td>
<td>30</td>
<td>3</td>
<td>247</td>
<td>$17.2</td>
<td>100%</td>
<td>$66.6</td>
<td>100%</td>
</tr>
<tr>
<td>2x2 MIMO</td>
<td>10</td>
<td>30</td>
<td>3</td>
<td>227</td>
<td>$18.5</td>
<td>108%</td>
<td>$63.9</td>
<td>96%</td>
</tr>
<tr>
<td>Beamform</td>
<td>10</td>
<td>30</td>
<td>3</td>
<td>154</td>
<td>$13.5</td>
<td>78%</td>
<td>$44.3</td>
<td>67%</td>
</tr>
<tr>
<td>MIMO+BF</td>
<td>10</td>
<td>30</td>
<td>3</td>
<td>116</td>
<td>$12.9</td>
<td>75%</td>
<td>$36.1</td>
<td>54%</td>
</tr>
</tbody>
</table>
Follow-on Mobile WiMAX Business Case Paper(s)

- Phase II paper(s) would provide more detailed financial analysis (payback, ROI, etc) for various scenarios:
  - Greenfield operator
  - 3G or 2G overlay
  - Wireline extension

- Requires service provider inputs for:
  - Core network cost estimates
  - OPEX estimates
  - ARPU projections
Next Steps

• Proceed with Phase I Business Case White Paper
  – With current or modified estimates for PBH calculations, channel capacity, and WiMAX equipment costs
  – Consider an FDD vs. TDD comparison (if there is sufficient interest)

• Continue to engage with willing service providers to collect additional data required for Phase II paper(s)
Thank You!

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